3252

JPRS: 3252

20 May 1960

THE SOVIET UNION OPENS UP A WAY TO THE COSMOS

- USSR -

by T. Mel'kumov

Distributed by:

OFFICE OF TECHNICAL SERVICES
DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.
(Price $.50)

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

F O R E W O R D

This publication was prepared under contract by the UNITED STATES JOINT PUBLICATIONS RESEARCH SERVICE, a federal government organization established to service the translation and research needs of the various government departments.

JPRS: 3252

CSO: 3807-D

THE SOVIET UNION OPENS UP A WAY TO THE COSMOS

[Following is a translation of an article by T. Mel'kumov Dr. Tech. Sc. Honoured Man of Science and Technology of the RSFSR in Molodoy Kommunist (Young Communist), No. 2, Moscow, Feb 60, pp 56 62]

For millenia the planets and stars have attracted man's attention The more boundless the universe seemed to man the more it beckoned to him, excited fantasies, and gave birth to the dream of seeing other worlds. And now this fantastic dream has now become a reality within the reach of mankind.

During the last two years the Soviet people have solved the problem which had defeated the mind of man: they have launched artificial earth satellites, created an artificial solar planet, sent a net load of 390 kg to the moon, have photographed the hidden face of the moon, and transmitted photographs back to earth. Each one of these achievements is outstanding and with reason the press has called them epoch-making.

On the basis of the successes which have been achieved in the investigation of space and in accordance with the plan for scientific research work in the USSR, tests have begun of more powerful ballistic multi stage rockets for launching heavy artificial earth satellites and for carrying out space flights to the planets of the solar system. On 20 January 1960 the first such rocket was successfully launched in our country.

All this is indisputable and generally recognized evidence that Soviet science and rocket technique have moved to the fore and left behind the science and rocket techniques of the capitalist countries including even those of the United States of America. Our people are rightfully proud of the history-making results of their work in the study and conquest of space, where each new step forward has been made by Soviet rocket scientists.

Soviet space rockets and artificial satellites have shown to the entire world the boundless possibilities of the socialist order. Socialism has become in our time the embodiment of the progress of human society, of the greatest triumph of the human mind, of the flowering of man's creative forces. The advantages of socialism over capitalism have become increasingly clear to all healthy-minded people.

"How are our great success to be explained?" asked Comrade N. S. Khrushchev. On the grounds that we are the smartest and the

most capable? If we would think this we would be completely wrong. The fact is that it is just our Soviet order, the socialist order, which creates the conditions for the people under which it can fully develop its creative forces and show what free men are capable of, men who do not know the burden of exploitation and who are the real masters of their country."

The clear superiority of Soviet science both in the scope of activities and also in the results achieved in the investigation of space are now recognized by all, including even American scientists.

Even the first Soviet earth satellite, the launching of which on 4 October 1957 opened the age of space conquest, weighed 83.6 kg. In the U.S.A. the first artificial satellite was launched almost six months later and weighed only 11 kg. While the weight of the second Soviet satellite was more than ten times that of the first, the total weight of the third satellite, launched in May 1958, was already equal to 1,327 kilograms!

During 1958 and 1959 several satellites were launched in the United States of America. The weight of the largest of them was 135 kilograms.

In launching the American satellites the main rockets used were the "Jupiter", "Thor", "Kessler," and "Atlas," about 95 tons. The rockets are of considerable length and diameter. For example, the diameter of a "Jupiter" rocket is 2.6 meters, and its length--18 meters. The diameter of an "Atlas" is somewhat more than 3 meters with a rocket body length of 24 meters; it is as high as a six or seven-story building. The thrust developed by the engines of the "Atlas" rocket is equal to about 180 tons, that is, six times that of all four engines of the American passenger jet airplane "Boeing 707", which carries more than 100 passengers.

But these rockets, despite their dimensions and powerful thrusts have proved unable to put the relatively small American satellites into orbit. It was necessary to add extra stages to them. For example, it was necessary to add three more stages to the "Jupiter" rocket for launching a satellite with a net weight of about 11 kilograms.

Until now the U.S.A. has successfully launched only one space rocket (March 1959) the net load weight of which amounts to only 6.1 kilograms, against 1,472 kilograms weight for the first Soviet space rocket which includes the net load, and the weight of last-stage rocket without fuel.

According to the statement by W. Braun, the famous German specialists who is working in the U.S.A. in making powerful rockets, the Americans will need at least another three years before they can make a rocket which will be equal to that of the second Soviet space rocket.

In order to carry out the gigantic and immensely complex tasks involved in the building of artificial satellites for

automatic interplanetary stations, Soviet scientists, engineers, and workers had to solve many separate major problems.

In order to lift the net load to a great altitude and imparting to it the first cosmic velocity relative to the earth (about 8 km per second), it was necessary above all to possess powerful and economic rocket engines.[1]

1 The first cosmic velocity permits the creation of an artificial earth satellite, which revolves in a circular or, as is usually the case, an elliptical orbit; the second cosmic velocity permits the rocket to escape the force of the earth's gravity and to travel into space. The second cosmic velocity is also called the escape velocity.

With their painstaking work and fruitful ideas, Soviet scientists, designers, and engineers have built powerful and suitable rocket engines equipped with a system which ensures their stable operation and control of thrust.

To build efficient engines it is necessary above all to have high-caloric fuel, in which the components--burning and oxidizing--yield the most desirable and efficient combustion products. Moveover, to achieve the necessary fuel economy the proper ratio of components must be selected as well as the right chamber pressure, and cooling system for the engines in the combustion chamber of which the temperature of gases reaches 3500°C.

Thus the first major problem in rocket building is the making of an extraordinarily light, reliable, and powerful rocket engine and efficient fuels for it together with development of the proper lightweight fuel supply, cooling, and guidance systems.

The second major problem is the selection of a design for the rocket as a whole and the design of all its elements. The main aims which must be achieved in the solution of this problem are a reduction in the weight of the construction of the rocket and its guidance mechanisms and insurance of the necessary reliability. K. E. Tsiolkovskiy showed in his famous work, "The Investigation of the Universe with Jet Devices," which was first published in 1903, that under otherwise equal conditions the less the relative weight of body of rocket, the greater the velocity that is communicated to it at the end of the operation of the engine, that is, at the moment when all the fuel in the tanks has been burned. This velocity is called the terminal speed of the active section (the section on which the motor is exerting its effect). Directly dependent on the terminal velocity which is attained by the active section are the altitude and distance of flight of the rocket, the possibility of creating an artificial earth satellite (first cosmic velocity) or a space rocket (second cosmic velocity).

A third problem is the guidance of the rocket as a whole. This involves the development of an automatic system which will guarantee the movement of the rocket along a computed trajectory, the positioning of the longitudinal axis of the rocket on this trajectory and control of the thrust. If necessary the system shuts off the engine after the necessary velocity has been attained, ejects the burned-out stages of the rocket and shuts off the last-stage engine when the necessary velocity and course have been achieved at a determined point in space. The complex automatic guidance system is located on the side of the rocket.

Another method is possible in which the necessary data on its speed and course are received on earth from the rocket and on command from the earth the guidance system of the rocket makes the necessary corrections in its movements. It is clear that in this case the rocket must be equipped with computing machines on the rocket and also apparatus for transmission of data back to earth. The entire procedure of command and correction of trajectory must be done in an exceptionally short space of time because the velocity of the rocket is enormous. For example, 20-30 minutes after the launching of the second lunar rocket results of radio-technical measurements from many tracking stations in the Soviet Union were received at the computation center which permitted the precise calculation of the flight trajectory of the rocket within the first hour and the prediction of both the time and place of its fall into the northern part of the moon. All this was brilliantly confirmed by the event.

The making of various measurements of distance in cosmic space is the main purpose behind the launching of artificial earth satellites and space rockets. The fourth problem, therefore, is the building of exceptionally light and small measuring instruments and telemetric devices for regulating the transmission of instrument reading back to earth. It is necessary also to build light and efficient chemical and solar sources of energy. For an understanding of the complexity of this task it is sufficient, for example to enumerate the measurements which were made with the aid of the apparatus on the first Soviet space rocket.

On board this rocket, apparatus was installed for the measurement of the earth's magnetic field and for detection of the magnetic field of the moon, for the study of interplanetary gases and the corpuscular radiation of the sun (study of material particles), recording of the heavy nuclei in primary cosmic rays and the intensity of cosmic radiation, study of meteoric particles; apparatus for the radio-control of the trajectory of the rocket; radio transmitters; a telemetering chassis intended for the transmission back to earth of all the scientific measurements; chemical and electric batteries as sources of electric energy, and a fan for mixing gases in the capsule. Attached to the side of the rocket also were two pennants with the State insignia of the USSR. Perhaps

sometime a man from earth or another intelligent being from another world may come upon the first space rocket and return these insignia to earth; unfortunately, this is not very likely.

A rocket represents an apparatus which is charged with an enormous amount of chemical energy. It is deserving of notice that the discharge of this energy (the period of operation of the rocket engine takes place in an extraordinarily short space of time and only during the initial active stage of the flight. The length of this stage is insignificantly small in comparison with that of even one revolution of the satellite around the moon. It is understandable, therefore, that the process of discharge of the rocket's energy must be sufficiently precise for the whole of the subsequent uncontrolled flight to follow the necessary trajectory.

As already stated, at a given point in space at the end of the active stage of the flight the nose of the rocket has acquired a completely controlled velocity and course. For example, in order to fall on the moon, the radius of which is 1,738 kilometers and which is moving around the earth at a speed of one kilometer a second, it is necessary that the velocity of the rocket at the end of the active period be accurate to within a few meters a second; its course, also, must be accurate to less than one-tenth of a degree. The time of launching of the rocket is also of enormous importance, calculating the movement of the moon and the rotation of the earth, the launching must be made within only a few seconds of the computed time.

An extremely important and difficult task was the photographing of the hidden side of the moon which was accomplished by the first Soviet automatic space station which was launched with the aid of the third space rocket. To obtain a picture of the required area of the moon's surface it was necessary to orient the automatic interplanetary station relative to the sun and the moon and to photograph the moon within a definite time interval.

The time of switching on both cameras, the exposure time, the development and fixing of the negatives and the transmission of the images obtained to the earth by television--all this was done completely automatically. It is particularly valuable that on the photographs received there is included part of the visible face of the moon which has been well studied and photographed on earth. This makes it possible, first, to evaluate more confidently the fidelity of the photographs, and, second, better to connect the images of the hidden face of the moon and names given to them: the Sea of Moscow and the Sea of Dreams, three craters, named after Tsiolkovskiy, Lomonosov and Joliet-Curie and the Soviet mountain range.

Some malicious and skeptical persons abroad have asserted that our second space rocket did not reach the moon, that none of the results published by us have been objectively proved. An answer

to these doubts and denials has been made by the famous English astronomer, A. C. B. Lowell, who is the director of the large Jodrell Bank Observatory which possesses an enormous radio telescope. Lowell tracked the movement of the second Soviet space rocket. He objectively established the approach of the rocket to the moon (he measured the frequency of the signals, because close to the moon the rocket's speed increased under the influence of the attraction of the moon) and also the very moment of contact of the rocket with the moon (the sudden cessation of radio signals from the already known trajectory of the rocket).

Outstanding specialists in Europe and America have still more enthusiastically hailed the achievements of Soviet science and technology after the convincing demonstrations afforded by the photographs of the hidden face of the moon.

The practicability of the accomplishment of new and still more daring tasks now cannot be questioned by anyone. This does not mean that we have now solved all the outstanding problems, especially those associated with man's flight in an interplanetary ship. Everyone understands, for example, that the sending of a man to the moon demands the building of equipment which will be capable not only of ensuring the normal functioning of the organism during the flight but also landing on the moon, escape from the moon, return to and landing on the earth. Man must return to the earth.

For the safe landing of equipment on the moon auxiliary engines are necessary as well as energy sources for them. An even larger supply of energy and more powerful engines are needed for overcoming the force of gravity during the take-off from the moon. Finally, the return of the ship to the earth requires the reduction of its velocity down to an acceptable figure by means of the unfolding of special supporting wings or by means of powerful braking engines for which a definite supply of energy is also required. If, upon the return to the earth, the necessary measures for reducing velocity are not taken, the ship will burn up in the atmosphere like a meteor. The first and second earth satellites burned up in this way as did several American satellites and their attempted moon rockets.

The sending of a space vehicle with a man to the moon is a considerably easier task than sending one to Mars or Venus. First of all, the moon is about 100 times closer to us than Venus and 200 times closer than Mars. Moreover, the gravitational field on the moon is much less because the mass of the moon is about one-tenth that of Mars and one-seventieth that of Venus. While the velocity of escape from the earth (or second cosmic velocity) amounts to 11.2 kilometers per second, the velocity of escape from the moon is only 2.4 kilometers per second; however, from Mars and Venus it is necessary to attain velocities of 5.27 and 10.4 kilometers per second respectively. Consequently, for the flight of an interplanetary space vehicle to Mars and Venus and for escape from them,

considerably more powerful engines are required and large stocks of fuel. Then it is necessary to consider the longer period of flight which poses additional problems concerning the feeding, respiration, and biological protection of man and also problems in the proper operation of all the instruments and mechanisms.

We have mentioned also the necessity of having motors on board an interplanetary ship as well as sources of energy for them. Without this the controlled flight of man in space would be impossible.

The sending of large masses into the neighborhood of a planet requires very powerful rockets. The use of the chemical energy of even the most efficient fuels makes these rockets enormous and of tremendous initial weight. For example, for a comparatively short flight of an interplanetary vessel weighing five tons a rocket using highly efficient chemical fuel with an initial weight of the order of 5000 tons is required.

In order to reduce the initial weight of the rocket and in addition to have energy sufficient for the guidance of its movement for a long flight, pressing thought is being given to the use of nuclear propulsion. To escape contaminating the air nuclear energy may be utilized after the launching which can be made by chemical fuel. If a high-temperature nuclear propulsion rocket engine can be successfully built then it is possible to calculate on obtaining from 1 kilogram of nozzle gases two or three times greater thrust than from a chemical fuel. This affords grounds for believing that the use of nuclear propulsion will permit a substantial reduction in the initial weight of the rocket.

The guidance of flight in space requires engines of relatively small power because the forces which are acting here on the space vehicle are not great. For this purpose solar and also nuclear energy can be used. At the present time designs and models of engines for space vehicles are being made in many countries.

Another possible solution of this task is the so-called ion engine in which solar or nuclear energy are converted into electrical energy. Most interesting is the development of a lightweight and efficient apparatus for the direct conversion of thermal energy into electrical energy. With the aid of an electric current some suitable substance (for example cesium) is ionized, that is the molecules or atoms of the substance are freed from their bonds with electrons. As a result negatively charged electrons are obtained and positively charged ions--the remains of the molecules or atoms. With the aid of electrical energy the ions and electrons are accelerated to very high velocities of the order to 50,000 to 100,000 meters per second and are ejected from the apparatus, creating a thrust. As a result, with a relatively small amount of energy, ejected for a long period of time, it is possible to accelerate an interplanetary vessel in space up to very great velocities. For example, a vessel weighing 5 tons to which is applied in space the thrust of an ion engine of only 110-115 grams,

can after a year of continuous operation of the engine reach a velocity of about 400 000 kilometers per hour, or about 110 kilometers per second. This is a great velocity if it is recalled that the speed of movement of the earth amounts to about 30 kilometers per second and the maximum velocity of a space vehicle at the moment of escape from the earth is less than 42 kilometers per second and with increasing distance from the earth it drops to 32-33 kilometers per second. Consequently, an ion engine with a total thrust of 110-115 grams, working uninterruptedly for a whole year, will double the speed of a space rocket.

We have shown one of the possible means of solution of the task of control of the movement of an interplanetary ship in space flight. The dimensions of the ship itself will be determined by the size of the crew, the total length of the flight, the number of stops at interplanetary stations or planets, the amount of necessary instruments, etc.

Not so long ago any discussion of such problems as flights to the moon and the nearest planets struck most people as groundless and fantastic. Now after the first brilliant steps have been made in this field by the Soviet people, daring plans are to seem much more practicable. Many different types of problems must still be solved before man will succeed in carrying out a flight in an interplanetary ship and returning to earth.

The practicability of interplanetary flight was strengthened by the Tass communique published in the press on 22 January 1960 on the launching of a powerful multi-stage ballistic rocket. The next-to-last stage of this rocket together with the dummy missile of the last stage, moving precisely along the computed trajectory and reaching a velocity of more than 26,000 kilometers per hour, landed in the waters of the Pacific Ocean in the target area, at a point about 12,500 kilometers along the earth's surface from the launching point. The last-stage dummy missile reached the surface of the water near the calculated point of impact. Covering an enormous distance, the rocket deviated from the point of impact by only two kilometers! Such is the high precision of the rocket's guidance system. The remarkable operation of the mechanisms at the launching and during the flight, the accurate functioning of the measuring system and apparatus are all clear evidence that Soviet science is persistently continuing the attack which it has begun on space. The launching of a powerful Soviet rocket will ensure the further progress of the human mind, energy, and talent along the road of mastery of the cosmos and the study of the planets of the solar system.

The Tass communique evoked numerous responses throughout the world. In the U.S.A., for example, they read that the American had again lost ground in the space race and that the powerful "Saturn" rocket under construction will be ready only in 1963-1964 and from the data given it cannot surpass the results which have been achieved in the USSR.

Soviet man is receiving with pride the constantly increasing evidence of the outstanding successes which our Fatherland is achieving under the leadership of the great Communist Party, successes which are moving all mankind forward on the path to a more profound comprehension of the universe and of the laws of nature and which contain no threat to the peaceful labor of all the peoples on the earth.

5031

- END -